

Docket No. 1567.1015/JGM

SERIAL NO. 09/910,952

IN THE CLAIMS:

Please **AMEND** elected claims 4, 8, 9, 11, 12, 29, and 30, and **AMEND** withdrawn claims 5-7, as follows:

1. (CANCELED)

2. (PREVIOUSLY PRESENTED) An electrolyte for a lithium-sulfur battery having a positive and negative electrode, comprising:
 a first solvent having a dielectric constant that is greater than or equal to 20;
 a second solvent having a viscosity that is less than or equal to 1.3; and
 an electrolyte salt,
 wherein:

said first solvent is at least one selected from a group consisting of methanol, hexamethyl phosphoramidate, ethanol, and isopropanol, and
 the first solvent is roughly between 20% and 80% by weight of the electrolyte.

3. (WITHDRAWN) The electrolyte for the lithium-sulfur battery of claim 2, wherein said second solvent is at least one selected from a group consisting of methylethyl ketone, pyridine, methyl formate, n-propyl acetate, ethyl ether, methylethyl carbonate, toluene, fluorotoluene, benzene, fluorobenzene, p-dioxane, and cyclohexane.

4. (CURRENTLY AMENDED) A lithium-sulfur battery comprising:
a positive electrode including an active material including lithium;
a negative electrode having another active material including sulfur; and
an An-electrolyte disposed between ~~for a lithium-sulfur battery having a~~ the positive and
negative electrodes, the electrolyte comprising:

a first solvent having a dielectric constant that is greater than or equal to 20;
 a second solvent having a viscosity that is less than or equal to 1.3; and
 an electrolyte salt,

wherein:

the first solvent is less than 30% and at or greater than 20% by weight of the electrolyte, and

SERIAL NO. 09/910,952**Docket No. 1567.1015/JGM**

the second solvent is roughly between 80% and about 60% by weight of the electrolyte.

5. (WITHDRAWN) The ~~electrolyte for the~~ lithium-sulfur battery of claim 4, wherein the electrolyte further comprising comprises an additive that forms a solid electrolyte interface (SEI) at a surface of the negative electrode during charging.

6. (WITHDRAWN) The ~~electrolyte for the~~ lithium-sulfur battery of claim 5, wherein said additive is at least one selected from a group consisting of vinylene carbonate, vinylene trithiocarbonate, ethylene trithiocarbonate, ethylene sulfite, ethylene sulfide and bismuth carbonate.

7. (WITHDRAWN) The ~~electrolyte for the~~ lithium-sulfur battery of claim 5, wherein said additive is roughly between 0.2% and 10% by weight of the electrolyte.

8. (CURRENTLY AMENDED) The ~~electrolyte for the~~ lithium-sulfur battery of claim 4, wherein said electrolyte salt is at least one selected from a group consisting of lithium hexafluorophosphate (LiPF_6), lithium tetrafluoroborate (LiBF_4), lithium hexafluoroarsenate (LiAsF_6), lithium perchlorate (LiClO_4), lithium trifluoromethane sulfonyl imide ($\text{LiN}(\text{CF}_3\text{SO}_2)_2$), and lithium trifluorosulfonate ($\text{CF}_3\text{SO}_3\text{Li}$).

9. (CURRENTLY AMENDED) The ~~electrolyte for the~~ lithium-sulfur battery of claim 4, wherein a concentration of said electrolyte salt is roughly between 0.5 M and 2.0 M.

10. (PREVIOUSLY PRESENTED) A lithium-sulfur battery comprising:
a negative electrode comprising a negative active material selected from a group consisting of lithium metal, lithium-containing alloy, a combination electrode of a lithium/inactive sulfur, a compound that can reversibly intercalate lithium ion, and a compound that can reversibly redoxdate with a lithium ion at a surface;
an electrolyte comprising a first solvent having a dielectric constant that is greater than or equal to 20, a second solvent having a viscosity that is less than or equal to 1.3, and an electrolyte salt; and
a positive electrode comprising a positive active material comprising at least one sulfur-based material selected from a group consisting of a sulfur element, Li_2S_n ($n \geq 1$), an organic

Docket No. 1567.1015/JGM

SERIAL NO. 09/910,952

sulfur compound, and a carbon-sulfur polymer $((C_2S_x)_n$ where $x=2.5$ to 50 and $n \geq 2$), and an electrically conductive material,

wherein

the first solvent is roughly between 20% and 40% by weight of the electrolyte, and the second solvent is roughly between 80% and about 60% by weight of the

electrolyte.

11. (CURRENTLY AMENDED) ~~An electrolyte for a~~ lithium-sulfur battery, comprising:

a positive electrode including an active material including lithium;

a negative electrode including another active material including sulfur; and

an electrolyte disposed between the positive and negative electrodes, the electrolyte

comprising

a first solvent having a polarity high enough to dissolve an ionic compound;

a second solvent having a viscosity that is less than or equal to 1.3; and

an electrolyte salt,

wherein

the first solvent is less than 30% and at or greater than 20% by weight of the electrolyte, and

the second solvent is roughly between 80% and about 60% by weight of the electrolyte.

12. (CURRENTLY AMENDED) A lithium-sulfur battery comprising:

a negative electrode comprising a negative active material including sulfur;

an electrolyte comprising

a first solvent having a polarity high enough to dissolve an ionic compound,

a second solvent having a viscosity that is less than or equal to 1.3, and

an electrolyte salt; and

a positive electrode comprising a positive active material including lithium.

wherein

the first solvent is roughly between 20% and 40% by weight of the electrolyte, and

the second solvent is more than 70% and at or less than 80% by weight of the

electrolyte.

SERIAL NO. 09/910,952

Docket No. 1567.1015/JGM

13. (ORIGINAL) The lithium-sulfur battery of claim 12, wherein the first solvent has a dielectric constant that is greater than or equal to 20.

14. (PREVIOUSLY PRESENTED) A lithium-sulfur battery comprising:
a negative electrode comprising a negative active material;
an electrolyte comprising

a first solvent having a polarity high enough to dissolve an ionic compound,
a second solvent having a viscosity that is less than or equal to 1.3, and
an electrolyte salt; and

a positive electrode comprising a positive active material,

wherein:

the first solvent is at least one selected from a group consisting of methanol,
hexamethyl phosphoramide, ethanol, and isopropanol,

the first solvent is roughly between 20% and 80% by volume of said electrolyte,

and

the second solvent is roughly between 20% and about 80% by volume of said
electrolyte.

15. (WITHDRAWN) The lithium-sulfur battery of claim 14, wherein the second solvent is at least one selected from a group consisting of methylethyl ketone, pyridine, methyl formate, n-propyl acetate, ethyl ether, methylethyl carbonate, toluene, fluorotoluene, benzene, fluorobenzene, p-dioxane, and cyclohexane.

16. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 14, wherein:
the first solvent is roughly between 20% and 40% by volume of said electrolyte, and
the second solvent is roughly between 80% and about 60% by volume of said electrolyte.

17. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 14, wherein a ratio of the first solvent to the second solvent is roughly 1:1.

18. (WITHDRAWN) The lithium-sulfur battery of claim 12, wherein said electrolyte further comprises an additive that prevents the formation of dendrite on a surface of said negative electrode during charging.

SERIAL NO. 09/910,952**Docket No. 1567.1015/JGM**

19. (WITHDRAWN) The lithium-sulfur battery of claim 18, wherein the additive forms a solid electrolyte interface (SEI) at the surface of said negative electrode.

20. (WITHDRAWN) The lithium-sulfur battery of claim 18, wherein the additive is at least one selected from a group consisting of vinylene carbonate, vinylene trithiocarbonate, ethylene trithiocarbonate, ethylene sulfite, ethylene sulfide and bismuth carbonate.

21. (WITHDRAWN) The lithium-sulfur battery of claim 18, wherein the additive is roughly between 0.2% and 10% by weight of said electrolyte.

22. (WITHDRAWN) The lithium-sulfur battery of claim 10, further comprising an additive that forms a solid electrolyte interface (SEI) at a surface of the negative electrode during charging.

23. (WITHDRAWN) The lithium-sulfur battery of claim 22, wherein said additive is at least one selected from a group consisting of vinylene carbonate, vinylene trithiocarbonate, ethylene trithiocarbonate, ethylene sulfite, ethylene sulfide and bismuth carbonate.

24. (WITHDRAWN) The lithium-sulfur battery of claim 23, wherein said electrolyte salt is at least one selected from a group consisting of lithium hexafluorophosphate (LiPF_6), lithium tetrafluoroborate (LiBF_4), lithium hexafluoroarsenate (LiAsF_6), lithium perchlorate (LiClO_4), lithium trifluoromethane sulfonyl imide ($\text{LiN}(\text{CF}_3\text{SO}_2)_2$), and lithium trifluorosulfonate ($\text{CF}_3\text{SO}_3\text{Li}$).

25. (WITHDRAWN) The electrolyte for the lithium-sulfur battery of claim 3, wherein said first solvent is sulfolane, and said second solvent is the toluene.

26. (WITHDRAWN) The electrolyte for the lithium-sulfur battery of claim 3, wherein said first solvent is sulfolane, and said second solvent is the n-propyl acetate.

27. (WITHDRAWN) The lithium-sulfur battery of claim 15, wherein said first solvent is sulfolane, and said second solvent is the toluene.

28. (WITHDRAWN) The lithium-sulfur battery of claim 15, wherein said first solvent is sulfolane, and said second solvent is the n-propyl acetate.

SERIAL NO. 09/910,952

Docket No. 1567.1015/JGM

29. (CURRENTLY AMENDED) The ~~electrolyte for the~~ lithium-sulfur battery of claim 4, wherein the first solvent is at least one selected from a group consisting of ethylene carbonate, propylene carbonate, dimethyl sulfoxide, sulforane, γ -butyrolactone, acetonitrile, dimethyl formamide, methanol, hexamethyl phosphoramidate, ethanol, and isopropanol.

30. (CURRENTLY AMENDED) The ~~electrolyte for the~~ lithium-sulfur battery of claim 4, wherein the second solvent is at least one selected from a group consisting of methylethyl ketone, pyridine, methyl formate, tetrahydrofuran, diglyme (2-methoxyethyl ether), 1,3-dioxolane, methyl acetate, 2-methyl tetrahydrofuran, ethyl acetate, n-propyl acetate, ethyl propionate, methyl propionate, ethyl ether, diethyl carbonate, methylethyl carbonate, dimethyl carbonate, toluene, fluorotoluene, 1,2-dimethoxy ethane, benzene, fluorobenzene, p-dioxane, and cyclohexane.

31. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 10, wherein said first solvent is at least one selected from a group consisting of methanol, hexamethyl phosphoramidate, ethanol, and isopropanol.

32. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 10, wherein the second solvent is more than 70% by weight of the electrolyte.

33. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 10, wherein the first solvent is less than 30% by weight of the electrolyte.

34. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 10, wherein the second solvent is substantially 80% by weight of the electrolyte.

35. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 10, wherein the first solvent is substantially 20% by weight of the electrolyte.

36. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 14, wherein the second solvent is more than 70% by weight of the electrolyte.

CERTIFICATE OF FACSIMILE TRANSMISSION
I hereby certify that this correspondence is being transmitted via facsimile to: Commissioner for Patents,
P.O. Box 1450 Alexandria, VA 22313-1450
on 17 Sep 04
By: Amber Miller
Date: 17 Sep 04
0000 8 of 14

SERIAL NO. 09/910,952

Docket No. 1567.1015/JGM

37. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 14, wherein the first solvent is less than 30% by weight of the electrolyte.

38. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 14, wherein the second solvent is substantially 80% by weight of the electrolyte.

39. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 14, wherein the first solvent is substantially 20% by weight of the electrolyte.

40. (PREVIOUSLY PRESENTED) The lithium-sulfur battery of claim 14, wherein said first solvent is at least one selected from a group consisting of methanol, hexamethyl phosphoramide, ethanol, and isopropanol.